WPS-0382

Policy, Research, and External Affairs

WORKING PAPERS

International Commodity Markets

International Economics Department
The World Bank
March 1990
WPS 382

The Indonesia Vegetable Oils Sector

Modeling the Impact of Policy Changes

Donald F. Larson

Liberalizing vegetable oil production in Indonesia would stimulate production, which is already expanding, but without new milling capacity, palm oil production gains are useless. And increasing export taxes would reduce export revenues.

Policy, Research, and External Affairs

WORKING PAPERS

International Commodity Markets

This paper — a product of the International Commodity Markets Division, International Economics Department — is part of a larger effort in PRE to develop a thorough understanding of primary commodity sectors in the developing countries. This information is useful both for commodity outlook work as well as for policy analysis. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington DC 20433. Please contact Dawn Gustafson, room S7-044, extension 33714 (61 pages with tables).

In two decades, Indonesia has become the world's second largest producer of palm oil and coconut oil. But Indonesia remains a price-taking producer of perennial (tree) crops in a market dominated by annual crops, particularly soybeans.

Indonesia has expanded production despite a Byzantine collection of price and quantity restrictions that affect both consumers and producers. But the Government of Indonesia appears ready to liberalize trade and increase private participation in the sector — recognizing both the limits of government financing and the importance of vegetable oils to the development of the Outer Islands.

Larson simulated the effects of trade liberalization on the sector and the effects of an export tax on tax and export revenues. His policy simulations show that:

Removing cumbersome government regulations would stimulate production but would not guarantee consumer benefits.

Whatever scenario is pursued, past investments in tree crops guarantee rapid expansion of production. But increased production does not give producers marketing power as they are unable to adjust supplies as quickly as producers of annual crops.

The rapid expansion of vegetable oil production may precipitate a domestic crisis in the palm oil milling industry, as milling capacity is stretched. Should new investments in milling fail to materialize, some production gains from existing trees will be squandered.

Should the export tax on vegetable oils increase, export revenues will drop. And some of the gains from tax revenues will be offset by reduced revenues from state-owned estates.

TABLE OF CONTENTS

THE INDONESIAN VEGETABLE OILS SECTOR: MODELING THE IMPACT OF POLICY CHANGES

I. INTRODUCTION AND MOTIVATION

1. The tree crop sector has been and remains a key component of the Indonesian economy. Rubber, oil palm and coconuts together occupy about 5.5 million hectares--about 20% of the cropped area in Indonesia, and generate 20% of non-oil export earnings. The sector employs 15% of the labor force, and from 1984 to 1986 generated 48,000 new jobs. The sector currently produces about 16% of agricultural GNP and is growing rapidly--especially oil palm and coconuts. Since 1970, the area devoted to coconuts has increased 76%, while the oil palm area has expanded by an incredible 432%. Rapid growth is forecast as well.

2. During the period 1980-85, employment in agriculture on Java grew at 0.9% p.a., contributing about 24% of total employment growth on Java. Employment in off-Java agriculture grew at 3.1% p.a. and contributed nearly 61% of total employment growth in the Outer Islands. Over 60% of the Indonesian population resides on Java, and labor absorption is a major challenge. Rice remains the major agricultural crop of Java but prospects for continued expansion are pessimistic. Uncultivated agricultural land on Java is virtually non-existent; all economically irrigatable land is already being used and most areas are already planted with high-yielding rice varieties.

The World Bank has supported ten operations in the Indonesian tree crop sector with a lending volume of about US$ 1 billion and considers the sector important, not only for its contribution to GDP and export revenue but also because of its strategic role in Outer Island development. A recent World Bank Staff Appraisal Report (World Bank, 1988) concluded that "...(T)hroughout Indonesia, food crops can be expected to absorb only limited amounts of additional labor, so the expansion of agricultural lands through exploitation of high-value tree crops may be the only effective means of generating growth and employment on a large scale in the Outer Islands."

3. In September, 1988 the World Bank sent a mission to Indonesia to evaluate the tree crop sector and provide recommendations to the Government regarding its future development. The model described in this paper was used to simulate policy alternatives for that study. In addition to the model description, this paper discusses the role of Indonesia as a producer of palm oil and coconut oil in a global context, provides a history of the sectors in Indonesia, as well as discussing the impacts of current government policies and model simulation results of the removal of existing restrictions on domestic and external trade in these industries. As well as supporting the policy role of the World Bank in Indonesia, this study provides input into the International Commodity Markets Division's ongoing analyses of the global outlook for the vegetable oils and meals industries.

II. INDONESIA AND THE GLOBAL MARKET

4. The fats and oils market is a highly integrated market characterized by substantial substitution possibilities in demand and diverse supply sources. The market encompasses oilseeds such as soybeans, rapeseed, and sunflowerseed, which are planted annually; crops such as oil palm and coconut palm which are perennials; and animal sources including butter, tallow and lard. Production decisions for annual crops are characterized by annual land allocation choices based on expected prices for meal and oil, while tree crop investment decisions are similar to other long-lived capital investment decisions. Animal fats production is the result of a set of complicated investment decisions involving the joint production of meat, dairy products and fat by-products. Fats and oils production is locationally diverse as well, with a variety of products produced and traded throughout the world. Table 2.1 conveys a sense of the wide distribution of fats and oils production. While North America and Europe are the dominant areas of production, large producers are found in South America and Asia as well. Although vegetable oil production is growing rapidly in Indonesia, the country remains a relatively medium-sized producer within the total fats and oils market.

5. The model presented in this paper is a model of Indonesia independent of other markets, and the analysis rests on the assumption that Indonesia is a price-taker in world markets. While Table 2.1 shows that Indonesia represents a small (3%) share of total fats and oils production, Indonesia is the world's

Table 2.1: 1987 PRODUCTION OF FATS AND OILS, BY REGION

Region	Production	Share
	--Million tons--	--%--
North America	12.5	17.2
EEC	11.4	15.7
Eastern Europe and U.S.S.R.	9.2	12.7
China	7.4	10.2
Malaysia	5.2	7.2
India	3.9	5.4
Brazil	3.5	4.8
Africa	2.8	3.9
Argentina	2.3	3.2
Indonesia	2.2	3.0
Japan	2.2	3.0
Philippines	1.5	2.1
Mexico	0.9	1.2
Other Europe	0.9	1.2
Turkey	0.8	1.1
Pakistan	0.6	0.8
Australia	0.6	0.8
Rest of the World	4.6	6.0
TOTAL	72.5	100

Source: Oil World Annual, 1988.

second largest producer of coconut oil (25%), and the second largest producer of palm oil (20%). Given the strong implications for policy analysis, the alternative hyothesis that the palm oil and coconut oil markets should be considered somehow distinct from the larger market for fats and oils deserves consideration.

6. However, the hypothesis that Indonesia holds price-setting market power in either the coconut oil or palm oil markets is rejected based on: (1) the known technical substitution possibilities among vegetable oils (2) the strong statistical evidence of price correlation among oils with varying supply conditions; (3) the inability of tree-crop vegetable oil production to expand or contract rapidly; and (4) the results of simulations of production shift effects in the context of a global model. The full arguments are given in Appendix A.

III. HISTORICAL SETTING

7. Although considered a "new" crop in Indonesia, palm oil was cultivated and used for soap production in Central Java by the mid-nineteenth century and oil palm plantations producing edible oil appeared in Sumatra by 1911. In 1938 about 90,000 hectares were planted in oil palm, but during World War II and the following years of early independence little growth occurred in most of the estate crops. In 1968, all nationalized former-Dutch estates were reorganized into 28 independent management units (PNPs/PTPs), 1/ and all other nationalized estates were returned to their previous owners. Expansion and rehabilitation plans were launched and new planting begun. Oil palm was considered more profitable than many of the other estate crops, and areas devoted to oil palm expanded rapidly. Areas planted in palm oil on government-owned estates grew from 84,000 hectares in 1969 to 176,000 hectares in 1979 and to 343,000 hectares in 1987 (Table 3.1). Large private estates expanded rapidly as well, growing from 35,000 hectares in 1969 to over 146,000 hectares in 1987. In addition to direct investment in oil palm, the Indonesian Government also sponsored small-holder development in oil palm. Lands have been cleared and planted near existing PTPs where small holders (2-4 hectares each) care for and harvest the trees. The crop is processed into Crude Palm Oil (CPO) at the PTP's crushing plant. These "people's plantations" are currently the most rapidly expanding type of cultivation

---

1/ PTPs (Perseroan Terbatas Perkebunan) and PNPs (Perusahaan Negasa Perkebunan) are both state owned estates. The PTPs have more limited liability under Indonesian law.

Table 3.1: INDONESIAN PALM OIL PRODUCTION

Date	Production (tons) Small Holders	State Estates	Private Estates	Harvested Area (hectares) Small Holders	State Estates	Private Estates
1970	0	147,003	69,824	0	86,640	46,658
1971	0	170,304	79,653	0	91,153	47,950
1972	0	189,261	80,203	0	96,562	55,497
1973	0	207,448	82,229	0	98,033	59,747
1974	0	243,641	104,035	0	117,513	64,223
1975	0	271,171	126,082	0	120,940	67,885
1976	0	286,096	144,910	0	141,333	69,772
1977	0	336,891	120,716	0	148,775	71,626
1978	0	336,224	165,060	0	163,465	68,651
1979	760	438,756	201,724	3,125	176,408	81,406
1980	720	498,908	221,544	6,175	199,338	89,047
1981	1,045	533,399	265,616	5,695	213,264	100,008
1982	2,955	598,653	285,212	8,537	224,440	96,924
1983	3,454	710,430	269,102	37,043	261,339	107,624
1984	4,031	814,015	329,144	40,552	340,511	130,958
1985	36,216	867,973	339,241	118,564	335,185	143,603
1986	53,504	912,306	384,919	129,904	332,694	144,182
1987	66,664	1,025,882	384,919	218,510	342,725	146,671

Source: Director General of Estates, Indonesia.

unit. Non-existent in 1978, small-holder area in 1987 (at 218,000 hectares) exceeded that of large private plantations. Palm oil production has expanded rapidly as well, with government estates again dominating the sector. Production on government estates grew from 129,000 tons in 1969 to 1.026 million tons in 1987. The large private estates produced over 60,000 tons in 1969 and 385,000 tons in 1987. Small-holder production is only beginning to come on-stream, yet 1987 production is estimated at 67,000 tons. Government-sponsored palm oil production, either directly or indirectly through small holders, is therefore responsible for about 74% of total production in Indonesia.

8. Cultivation of coconut trees in Indonesia is dramatically different in scale from the cultivation of oil palm. Fresh fruit bunches of oil palm must be processed quickly after harvesting and crushing plants are typically built at the hub of an estate extending over 5,000 hectares. Ninety-eight percent of the area planted to coconuts in Indonesia is cultivated by small-holders, typically in groves of less than two hectares (Table 3.2). The total coconut area has grown consistently, however, increasing from 1.2 million hectares in 1970 to 3.2 million hectares in 1987 (Table 3.2).

9. Of the 3.2 million hectares, 3.1 million hectares are managed by small-holders with little or no government support. Government ownership is extremely limited at 14,000 hectares, and large estates account for only 42,000 hectares. Despite the availability of new, high-yielding varieties of palm, yields have remained stable and low at around 0.6 tons per hectare (copra equivalent)--suggesting that the maturity and varietal composition of

Table 3.2: INDONESIAN COCONUT PRODUCTION

	Production (tons copra Eq.)			Harvested Area (hectares)		
Date	Small Holders	State Estates	Private Estates	Small Holders	State Estates	Private Estates
1970	1,198,863	1,749	2,290	1,789,262	5,928	10,541
1971	1,273,935	2,068	3,576	1,870,564	6,453	11,180
1972	1,248,739	3,007	4,205	1,889,682	6,982	11,556
1973	1,274,441	1,626	3,859	1,989,618	6,969	12,48[illegible]
1974	1,335,441	1,495	6,475	2,108,591	6,691	15,2[illegible]
1975	1,380,929	3,495	5,545	2,193,097	7,694	16,274
1976	1,526,577	3,253	4,811	2,304,790	9,243	14,800
1977	1,541,996	3,320	21,231	2,393,112	10,182	58,072
1978	1,553,763	3,527	20,952	2,454,115	9,234	42,212
1979	1,596,191	3,612	22,284	2,520,938	10,405	48,230
1980	1,629,726	3,701	32,646	2,622,206	15,050	43,167
1981	1,764,567	3,887	24,468	2,752,386	15,075	57,401
1982	1,587,177	4,457	11,411	2,808,989	13,411	29,764
1983	1,590,173	3,443	14,022	2,890,681	16,683	39,346
1984	1,737,263	2,430	10,795	2,958,170	14,197	39,113
1985	1,905,241	4,147	11,043	2,993,442	14,642	40,916
1986	1,950,290	7,628	16,724	3,056,575	14,271	41,682
1987	1,984,522	7,628	16,724	3,119,295	14,291	41,682

Source: Director General of Estates, Indonesia.

the tree stock has remained fairly constant over the last two decades. The steady expansion of coconut trees in Indonesia appears to have a life of its own. A simple linear trend which mimics population growth, explains over 99% of the expansion in coconut area over this period, leaving little room for relative price impacts on investment. However, coconut production from planted areas does respond to changes in real prices through harvesting intensification, as will be shown in the model discussion.

10. The stability of yields and the failure to adopt high-yielding varieties of coconut palm in Indonesia remains somewhat of a mystery. Anecdotal evidence indicates that the most prolific of the high-yielding varieties, the dwarf hybrid, is unpopular since the nuts are smaller and the shorter trees cannot be easily intercropped. However, other tall varieties are available which produce yields significantly higher than varieties presently in use, and yet these have not been adopted either. It has also been convincingly argued that farmers are reluctant to cut down palm trees that are yielding any nuts--even when those trees are well over 60 years old. Yet, every year, 30-60 thousand hectares of new land are planted in coconuts. Therefore, a large number of trees have been planted and have matured during the past two decades of stable yields. A third argument which seems reasonable, is that because of the long gestation period and long life of coconut trees the "demonstration effect" of the new varieties is quite slow. Unlike annual crops, in which results are demonstrated each year, the results from planting tree crops are much delayed. While demonstration effects grow geometrically, the four to seven year wait between "generations" of effects is likely to slow substantially the full impact of the new

technology. In addition, technologically progressive farmers who do plant improved varieties of coconut reap the benefits four to seven years after planting, but may suffer a loss in the early years due to increased input requirements and outlays for planting material. If future income is highly discounted, as is likely the case among small-holders, these up-front expenses are a strong disincentive.

11. While the total supply of coconuts does not seem responsive to economic variables, the allocation of nuts to the copra industry does seem responsive to price and income movements. In 1970, 47% of the total coconut production was crushed as copra to produce meal and oil. As prices jumped in the mid-1970s, more than 63% of production moved into the formal copra milling sector. This share dropped as prices fell in 1985 and 1986, but with the sharp price increase in 1987 the share increased again to about 60% of production.

IV. DOMESTIC MARKETING AND GOVERNMENT POLICY

12. The composition of the domestic market for coconut oil (CCO) and palm oil has changed dramatically over the past two decades. In 1971, 93% of total expenditures on crude vegetable oil were devoted to coconut oil (see Table 4.1). Domestic use of coconut oil was greater than 373,000 tons, while of the 250,000 tons of palm oil produced in Indonesia, only 24,000 tons were used locally. As the decade progressed, palm oil's market share grew steadily--reaching about 24% of expenditures in 1980. Over the past eight years, however, domestic use of palm oil has expanded even more rapidly and is currently about 40% of domestic expenditures. In physical terms, domestic use of palm oil now exceeds that of coconut oil. In 1987 domestic use of coconut oil dropped to 605,000 tons (from 750,000 tons in 1986), while domestic demand for palm oil grew from 601,000 tons to 757,000 tons. The motivation for the substitution of palm oil for coconut oil is easy to understand. Palm oil has historically had a discount to coconut oil on international markets, yet both crude oils are essentially equivalent as inputs for a variety of uses. It is possible to manufacture refined cooking oils from each which have no taste differences; margarine and shortening can be made from both products; both can be used to add fat content to dairy products made from dried milk; and both can be used for some types of soap. But to fully understand the timing of the substitution, and its potential impact on market prospects, it is important to understand the domestic marketing environment for vegetable oils in Indonesia.

Table 4.1: INDONESIAN CONSUMPTION OF VEGETABLE OILS

Year	Coconut Oil	Palm oil	Share of Vegetable Oil Expenditure for Palm Oil
	-------('000 tons)-------		-------(%)--------
1971	373	24	3
1975	500	48	9
1980	629	232	24
1985	562	769	43
1987	605	757	40

13. The Government of Indonesia jointly pursues a variety of policy goals with respect to the vegetable oils market. Cooking oil is one of the nine commodities which the government has designated as "essential" and the provision of cooking oil at a price consumers can "afford" has been a key objective of government policies. However, the government is also committed to providing a "fair" price to producers, and insuring an adequate supply of raw vegetable oil to processors. At the same time, the government is committed to protecting the processing industry as well as to increasing export revenue generated by the vegetable oil sector. These objectives are difficult to pursue simultaneously and are often at odds, leading to a proliferation of market intervention policies--including both quantity and price restrictions, a central marketing organization, and tax policies.

14. In order to insure adequate supplies of raw material for the domestic industry, representatives of the Ministries of Trade, Agriculture, and Industry convene each year to allocate a portion of CPO production to each of the major competing industrial users--including fractionation (breaking the original oil into component fatty-acids) and refining, margarine and shortening production, soap production, chemical uses, and animal feed. In addition, in order to keep prices stable and to ensure processing profitability, an official "allocation price" is designated. With the exception of 1986 when palm oil prices hit an historic low, allocation prices have fallen below world prices (Table 4.2). Plantations owned by the state and by joint-foreign ventures are obligated to provide a portion of their production to a Joint Marketing Organization (JMO) which handles the implementation of the allocation scheme.

15. Since coconut production is so widely diversified, there is no equivalent allocation scheme for coconuts (although there have been a number of local laws and taxes which discourage inter-island transport of either fresh nuts or copra). However, to ensure adequate supplies of all vegetable oils, quantitative and licensing export restrictions apply to both crude palm and coconut oil. Historically, government approval for coconut oil or copra exports has been rare. Earlier, coconut oil was devoted first to meeting domestic demand with palm oil used to supplement, but not displace, domestic coconut oil demand. More recently, as palm oil has gained increasing acceptance as a less-expensive alternative in cooking oil, the government has allowed increasing exports of coconut oil. Copra exports are still rare, in order to provide protection to domestic crushers. Until recently, imports of

Table 4.2: PRICES OF PALM OIL

(Rp '000/ton)

Year	Official Allocation Price	Rotterdam Price
1970	90	94
1971	90	103
1972	100	90
1973	120	157
1974	120	278
1975	120	180
1976	120	168
1977	120	220
1978	175	265
1979	210	407
1980	220	367
1981	260	360
1982	260	294
1983	295	455
1984	295	748
1985	425	556
1986	400	346
1987	425	562

Source: World Bank, Washington, D.C.

palm oil, coconut oil, and copra were forbidden, providing protection to farmers. Exports, which are licensed, are subject to a two-tiered tax system. There is a fixed tax of 0-5% and an additional variable "special" tax, intended to make up the difference between domestic prices and international prices. As the domestic price is fixed, and international prices fluctuate daily, the special tax often fails to bridge the gap between domestic and international prices, creating numerous incentives to circumvent the tax and the physical trade restrictions.

16. As mentioned earlier, the government either directly, or indirectly through its sponsorship of small holders, produces most of the palm oil in Indonesia. As a result, the government has in the past encouraged production growth through direct investment in the sector. In addition, domestic production has been stimulated by other programs. Many of the best potential sites for palm development are in areas of Sumatra and Kalimantan for which property rights are allocated by local custom rather than by strict legal deed. At the same time, Indonesian oil palm plantations are typically built on a scale involving 5,000 hectares or more. Investors without sufficient knowledge of local conditions are unable to amass sufficient tracts of contiguous land.

17. Current programs often offer investors access to large tracts of land deeded to the central or local governments, circumventing the need to negotiate land-use rights with multiple (often contending) parties. Loans at subsidized rates are also included, greatly increasing already strong investment incentives. In addition, the government often provides roads and

other forms of infrastructure. Fertilizer prices are subsidized in Indonesia as well, decreasing operating costs and increasing profit margins for the plantations. At the same time, however, complicated government allocation rules and high processing costs provide contradictory disincentives.

18. The net effect of government policies with respect to palm and coconut oil are mixed for producers, but more clear for consumers. For the consumer, despite policies which tend to reduce the price of crude oil inputs to processors, potential consumer savings are limited by concentration in the processing sector and restrictive licensing of imports. Empirical evidence would indicate that cooking oil prices in Indonesia have been higher than world prices (Table 4.3). In only seven of the 55 months covered in Table 4.3 was cooking oil produced from palm oil in Indonesia less expensive than cooking oil produced from palm oil in Europe. In only 16 of the 55 months was the price of coconut oil produced in Indonesia less than the price of refined coconut oil in Europe. In the first seven months of 1988, Jakarta cooking oil prices were 23% above an equivalent export parity price. Despite the decontrol of prices of olein, stearin and refined coconut oil in December 1987, cooking oil prices have not returned to international levels. In July of 1988, RBD stearin in Medan sold for 748 Rp/Kg compared to an f.o.b. price of 680 Rp/Kg.

19. For the producer, the allocation responsibilities imposed on oil palm plantations result in a net decrease in producer revenue as do restrictions on exports of copra, coconut oil and palm oil. Export taxes further increase the wedge between world and domestic prices. At the same time, given the rapid

Table 4.3: A COMPARISON OF INDONESIAN AND ROTTERDAM COOKING OIL PRICES

Year/ Month	Cooking Oil from CPO Jakarta (Rp/Kg)	Cooking Oil from CPO Rotterdam (Rp/Kg)	% (1)/(2)	Cooking Oil from CCO Jakarta (Rp/Kg	Cooking Oil from CCO Rotterdam (Rp/Kg)	% (1)/(2)
1984						
1	1,007	1,041	97	1,071	1,097	98
2	867	1,057	82	938	1,188	79
3	840	864	97	963	1,152	84
4	860	873	98	1,052	1,180	89
5	771	975	79	1,044	1,348	77
6	750	800	94	1,027	1,468	70
7	750	647	116	997	1,306	76
8	750	672	112	971	1,107	88
9	750	675	111	848	1,200	71
10	750	694	108	807	1,206	67
11	750	7111	105	804	1,019	79
12	750	672	112	798	944	85
1985						
1	731	698	105	777	951	82
2	725	675	107	775	840	92
3	744	725	103	838	937	89
4	770	829	93	850	854	99
5	767	765	100	786	735	107
6	750	681	110	740	639	116
7	720	572	126	723	578	125
8	574	511	112	577	507	114
9	588	457	129	605	474	128
10	547	411	133	575	478	120
11	512	428	120	541	442	122
12	605	480	126	584	439	133
1986						
1	637	424	150	687	431	159
2	624	374	167	623	361	173
3	592	345	172	588	332	177
4	539	372	145	554	302	184
5	511	369	139	556	264	210
6	479	378	127	533	288	185
7	480	293	164	525	249	210
8	585	318	184	599	239	250
9	612	455	134	626	395	159
10	653	567	115	717	707	101
11	774	631	123	867	646	134
12	707	572	124	616	649	126

Table 4.3: A COMPARISON OF INDONESIAN AND ROTTERDAM COOKING OIL PRICES (Continued)

Year/ Month	Cooking Oil from CPO Jakarta (Rp/Kg)	Cooking Oil from CPO Rotterdam (Rp/Kg)	% (1)/(2)	Cooking Oil from CCO Jakarta (Rp/Kg	Cooking Oil from CCO Rotterdam (Rp/Kg)	% (1)/(2)
1987						
1	728	651	112	826	699	118
2	768	653	118	862	663	130
3	744	615	121	82[illegible]	566	147
4	707	620	114	780	640	122
5	700	615	114	778	666	117
6	713	628	114	840	741	113
7	681	577	118	789	728	108
8	650	612	106	791	787	100
9	679	641	106	842	789	107
10	698	638	109	833	561	149
11	707	671	105	818	638	128
12	822	781	105	899	666	135
1988						
1	968	957	101	1,054	962	110
2	880	819	107	975	901	108
3	783	731	107	918	877	105
4	781	750	104	934	865	108
5	791	772	102	961	906	106
6	917	887	103	1,080	1,044	103
7	945	872	108	1,144	1,132	101

Note: Exchange rates used to convert world market prices to rupiah equivalents are annual average market exchange rates:

1984	US$1.00 = Rp. 1,026
1985	US$1.00 = Rp. 1,111
1986	US$1.00 = Rp. 1,134
1986 (post September)	US$1.00 = Rp. 1,644
1987	US$1.00 = Rp. 1,644
1988	US$1.00 = Rp. 1,700

World Bank Prices are Cif Rotterdam as reported in Oil World. Domestic prices are quotations from the Department of Trade reported monthly.

expansion of both oil palm and coconut, it is hard to argue that the net incentives for investment are not positive. Access to large areas of land as well as subsidized investment capital are strong incentives, and investment has been and is likely to remain strong, especially in oil palm plantations. Given the inability of the allocation procedures to lower domestic consumer prices, despite lowering farm gate prices, it must be assumed that most of the benefits of the current system of marketing fall to processors and distributors. This segment of the market already enjoys some measure of protection due to low labor and transportation costs because of their proximity to raw inputs such as CPO and copra.

V. FUTURE GOVERNMENT POLICIES IN PALM OIL

20. As noted earlier, the government of Indonesia has played an active role in the palm oil sector through direct investments via PTPs, small-holder programs, and the private sector incentives. During the next five-year plan (Repelita V) which begins in 1989, direct government investments are likely to remain small as low petroleum prices have limited government revenues. As a result, the government has initiated an alternative investment program which emphasizes private investment and management spurred by government incentives. The program, Pir-Trans, contains elements which have appeared in earlier programs but is unique in that it assigns small-holder development assistance responsibilities to private sector investors--a role traditionally reserved for state-owned estates. Under Pir-Trans, the government would be responsible for infrastructure development such as roads, bridges, and electricity. The government would also facilitate the acquisition of property-use rights, an obstacle which has greatly limited private investment in the past. Land clearing would be handled by contractors, often in exchange for logging rights. Private investors would have access to credit at concessionary rates and would finance estate development, new crop planting and palm oil crushing facilities. Around this privately-managed center or nucleus, an area up to four-times as large would be devoted to small-holder development. Government resources would be used to finance small-holder plantings, initial living expenses and housing. The nucleus would be responsible for providing extension services, collecting harvested fruit bunches, and processing the bunches into crude palm oil.

21. As we will see, assumptions concerning the success of Pir-Trans in continuing what has been rapid investment in the palm oil sector are important to the latter part of the projection period to the year 2000. Investment in new plantings during Repelita V will have negligible impact through the end of the plan in 1994, but, if sufficiently large, could prove important for the last six years of the projection period.

22. Generally speaking, the Pir-Trans program is open to all tree crops; however, to date, the private sector has limited its interest to palm oil with the exception of a single cocoa project on Kalimantan. As of October, 1988 projects involving over 376,000 hectares had been approved by the Director General of Estates under the Pir-Trans program for development through 1994. Another 124,000 hectares were under consideration at that time. Tables 5.1 and 5.2 give a listing of these projects by implementation data. The numbers given in the tables do not include the expansion of existing private estates, nor do they include private investment outside of the Pir-Trans program (for example, plantings on private estates owned by nationals which are eligible for other credit programs.) Adding in new area from other sources to the Pir-Trans schedule would bring total new area investment to 75-80,000 hectares annually, a large area even by the standards of recent years. There are several reasons why this schedule may be overly optimistic. Over 70% of the area under Pir-Trans as it stood in October, 1988 would be devoted to small holders which would be 100% government-financed. In addition, roads, housing, and other facilities would have to be constructed at an unparalleled rate, placing an extremely heavy burden on a government with dwindling revenues for investment. Also, as can be seen in Tables 5.1-5.2, most of

Table 5.1: APPROVED PIR-TRANS Projects by Province

	Total Program	Repelita IV				Total Repelita IV	Repelita V					Total Repelita V	Repelita VI		Total Repelita VI
		1985/86	1986/87	1987/88	1988/89		1989/90	1990/91	1991/92	1992/93	1993/94		1994/95	1995/96	
A. Private Sector															
1. RIAU	Smhdl 55,320	0	0	3,020	9,500	12,520	13,000	13,000	11,500	10,300	5,000	52,800	0	0	0
	Nucleus 16,330	0	0	1,000	2,380	3,380	2,850	4,250	3,150	1,700	1,000	12,950	0	0	0
2. JAMBI	Smhdl 75,840	0	0	0	500	500	9,540	16,400	17,400	17,600	9,200	70,140	2,800	2,400	5,200
	Nucleus 26,460	0	0	0	2,000	2,000	4,710	5,600	6,100	3,300	3,550	23,260	600	600	1,200
3. SUMATERA	Smhdl 17,000	0	0	0	1,200	1,200	2,000	3,300	4,500	3,000	3,000	15,800	0	0	0
SELATAN	Nucleus 8,000	0	0	0	300	300	500	1,200	2,000	2,000	2,000	7,700	0	0	0
4. SUMATERA	Smhdl 6,000	0	0	0	500	500	1,000	1,500	1,500	1,500	0	5,500	0	0	0
BARAT	Nucleus 4,000	0	0	0	2,000	2,000	2,000	0	0	0	0	2,000	0	0	0
5. KALIMANTAN	Smhdl 35,300	0	0	0	0	0	500	7,200	8,100	10,000	9,500	35,300	0	0	0
BARAT	Nucleus 16,700	0	0	0	500	500	1,500	6,200	6,200	1,300	1,000	16,200	0	0	0
6. KALIMANTAN	Smhdl 8,000	0	0	0	0	0	0	1,200	2,400	3,200	1,200	8,000	0	0	0
TENGAH	Nucleus 2,200	0	0	0	0	0	0	300	600	800	300	2,000	0	0	0
7. KALIMANTAN	Smhdl 3,000	0	0	0	0	0	0	1,500	1,500	0	0	3,000	0	0	0
TIMUR *	Nucleus 750	0	0	0	0	0	0	750	0	0	0	750	0	0	0
8. SULAWESI	Smhdl 8,000	0	0	1,200	2,000	3,200	2,800	2,000	0	0	0	4,800	0	0	0
SELATAN	Nucleus 2,000	0	0	300	500	800	700	500	0	0	0	1,200	0	0	0
9. SULAWESI	Smhdl 6,000	0	0	0	0	0	1,000	2,000	3,000	0	0	6,000	0	0	0
TENGAH	Nucleus 4,000	0	0	0	0	0	2,000	2,000	0	0	0	4,000	0	0	0
TOTAL A:	Smhdl 224,460	0	0	4,220	13,700	17,920	29,840	48,100	49,900	45,600	27,900	201,340	2,800	2,400	5,200
	Nucleus 80,240	0	0	1,300	7,680	8,980	14,260	20,800	18,050	9,100	7,850	70,060	600	600	1,200
B. INTI PT. PERKEBUNAN (PTP)															
1. SUMATERA	Plasma 9,300	0	0	0	0	0	1,200	2,000	2,000	2,000	2,100	9,300	0	0	0
UTARA	Inti 6,200	6,200	0	0	0	6,200	0	0	0	0	0	0	0	0	0
2. RIAU	Plasma 12,000	500	5,500	0	3,500	9,500	2,500	0	0	0	0	2,500	0	0	0
	Inti 8,000	3,500	0	0	2,000	5,500	1,500	1,000	0	0	0	2,500	0	0	0
3. JAMBI	Plasma 16,000	0	5,500	0	4,000	9,500	4,000	2,500	0	0	0	6,500	0	0	0
	Inti 4,000	0	2,000	0	0	2,000	0	2,000	0	0	0	2,000	0	0	0
4. SUMATERA	Plasma 12,000	0	0	0	0	0	0	2,500	3,000	3,500	3,000	12,000	0	0	0
SELATAN	Inti 3,000	0	0	0	0	0	0	1,000	1,000	1,000	0	3,000	0	0	0
5. KALIMANTAN	Plasma 4,500	0	0	0	750	750	750	750	750	750	750	3,750	0	0	0
BARAT	Inti 3,000	1,198	1,802	0	0	3,000	0	0	0	0	0	0	0	0	0
TOTAL B:	Plasma 53,800	500	11,000	0	8,250	19,750	8,450	7,750	5,750	6,250	5,850	0	0	0	0
	Inti 24,200	10,898	3,802	0	2,000	16,700	1,500	4,000	1,000	1,000	0	7,500	0	0	0
TOTAL A AND B:	Plasma 278,260	500	11,000	4,220	21,950	37,670	38,290	55,850	55,650	51,850	33,750	253,390	2,800	2,400	5,200
	Inti 104,440	10,898	3,802	1,300	9,680	25,680	15,760	24,800	19,050	10,100	7,850	77,560	600	600	1,200

* Cocoa

Source: Director General of Estates, 1988.

Table 5.2: APPLICATIONS ON PROJECTS UNDER PIR-TRANS (HECTARES)

		Repelita IV				Total Repelita IV	Repelita V					Total Repelita V	Repelita VI		Total Repelita VI
	Total Program	1985/86	1986/87	1987/88	1988/89		1989/90	1990/91	1991/92	1992/93	1993/94		1994/95	1995/96	
I. APPROVED															
A. INTI SWASTA	Smhdl 224,460	0	0	4,220	13,700	17,920	29,840	41,100	49,900	45,600	27,900	201,340	2,800	2,400	5,200
(Private)	Nucleus 80,240	0	0	1,300	7,680	8,980	14,260	20,800	18,050	9,100	7,850	70,060	600	600	1,200
B. INTI PT.	Plasma 53,800	500	11,000	4,220	21,950	37,670	8,450	7,750	5,750	6,250	5,850	34,050	0	0	0
PERKEBUNAN (PTP)	Inti 24,200	10,898	3,802	1,300	9,680	25,680	1,500	4,000	1,000	1,000	0	7,500	0	0	0
TOTAL I:	Plasma 278,260	500	11,000	8,400	35,650	55,590	38,290	55,850	55,650	51,850	33,750	233,390	2,800	2,400	5,200
	Inti 104,440	10,898	3,802	2,600	17,360	34,660	15,760	24,800	19,050	10,100	7,850	77,560	600	600	1,200
II. PROPOSED															
A. INTI SWASTA	Smhdl 87,000	0	0	0	0	0	0	7,000	17,000	21,500	22,500	68,000	16,000	3,000	19,000
(Private)	Nucleus 53,000	0	0	0	0	0	0	4,500	11,250	15,250	15,500	46,500	6,000	0	6,000
B. INTI PT.	Plasma 6,000	0	0	0	0	0	0	1,000	1,500	1,500	1,500	5,500	500	0	500
PERKEBUNAN (PTP)	Inti 4,000	0	0	0	0	0	0	500	1,000	1,000	1,000	3,500	500	0	500
TOTAL II:	Plasma 93,000	0	0	0	0	0	0	8,000	18,500	23,00	24,000	73,500	16,500	3,000	19,500
	Inti 57,000	0	0	0	0	0	0	5,000	12,250	16,250	16,500	50,000	6,500	0	6,500
TOTAL I AND II:	Plasma 371,260	500	11,000	8,440	35,650	55,590	38,290	63,850	74,150	74,850	57,750	308,890	19,300	5,400	24,700
	Inti 161,440	10,898	3,802	2,600	17,360	34,660	15,760	29,800	31,300	26,350	24,350	127,560	7,100	600	7,700

Source: Director General of Estates, 1988.

the projects are located in areas without large local populations readily available to fill the need for construction workers, plantation workers, and later small-holders. In recent years, most of the investment in oil palm plantations has occured in Sumatra. Under the Pir-Trans program this would continue with a 60% of the investment appearing around Riau and Jambi (an area located in the central-western portion of Sumatra). Development in these areas should move more rapidly as some of the existing infrastructure is in place. However, opening up new areas in Sulawesi and especially Kalimantan will require substantial upfront investment in infrastructure, which will take some time to complete.

23. In order to project production beyond 1995, an assumption had to be made as to the impact of Pir-Trans. The private sector in Indonesia, though leery about small-holder development responsibilities, appears genuinely interested in the early stages of Pir-Trans--especially since the program facilitates the acquisition of property use rights. In addition, with private sector costs for palm oil at less than $220 per ton, and world market prospects near $400 per ton, most projects appear very profitable even when producers receive less than world market prices. At the same time, government obligations under the program appear quite burdensome and it is likely that the anticipated expansion of the proportionately larger small-holder development aspects of the program will require more time than has been allocated. Taking this into account, it is assumed that total investment in new oil palm areas will continue to expand quite rapidly, averaging about 50,000 hectares annually.

VI. INDONESIAN MODEL DESCRIPTION

Demand

24. While production changes in Indonesia have a limited effect on global prices, the domestic market within Indonesia does react dynamically to world and domestic events and policies. In order to quantify the effects of possible policy alternatives for Indonesia, a small econometric model of the sector was estimated. The remainder of the paper is devoted to a description of the model and a discussion of projections under several scenarios. The model consists of 24 equations which simultaneously determine palm oil production, the production of coconuts, coconut crushing, fresh coconut use, coconut oil production, total expenditures for vegetable oils and the share of expenditures devoted to palm oil and coconut oil, as well as the export of palm oil and coconut oil. While the detailed model specification is given in Annex C, the main components of the model are explained below.

25. The demand for vegetable oils is modeled using Deaton and Muellbauer's (1980) Almost Ideal Demand System which is a two-stage budgeting model of consumer demand (see Annex B). Total expenditure per capita devoted to vegetable oils is determined in the first stage as a function of total income (private consumption levels) per capita, an aggregate index of vegetable oil prices, and the price of rice (the major food staple in Indonesia). All prices are deflated by the Indonesian Consumer Price Index. Expenditure share equations are specified as a function of relative prices of

coconut oil and palm oil and total vegetable oil expenditures--all deflated by an endogenously-determined index of vegetable oil prices. The shares are then applied to the first-stage expenditure level, and multiplied by population to derive domestic demand for coconut oil and palm oil.

26. Table 6.1 provides the second-stage compensated price and expenditure elasticities for palm oil and vegetable oil for the years 1970, 1980 and 1985. The results from two different specifications are presented. Both are fully constrained to meet the theoretical restrictions. However, one system is specified in terms of Manser's (1976) habit-formation model while the other is specified without lagged variables.

27. The results from the two models are quite similar. In the early years of the sample period, when coconut oil dominated domestic vegetable oil consumption, coconut oil demand remained relatively price and expenditure inelastic. With domestic demand initially at very low levels, the percentage responses of palm oil consumption to income and price changes were large. As palm oil consumption grew, expenditure elasticities remained low for coconut oil, although the price responsiveness increased. The income and price of palm oil fell while the cross-price elasticities remained steady and relatively large. 1/

1/ The time-paths which the income elasticities of vegetable oils exhibit are quite normal for food items which tend to respond sharply to per capita income increases at low levels, but respond less as incomes rise. Projections using constant-elasticity-demand schedules therefore tend to over-estimate income responses.

Table 6.1: COMPENSATED PRICE AND EXPENDITURE ELASTICITIES (HOMOGENEITY AND SYMMETRY IMPOSED)

Levels at Year		Habit Model /a			No-Habit Model		
		Price Coconut Oil	Price Palm Oil	Expenditure	Price Coconut Oil	Price Palm Oil	Expenditure
1970	Coconut oil	-0.3	1.8	0.53	-0.3	2.3	0.60
	Palm oil	1.8	-13.3	4.09	2.3	-15.1	3.67
1980	Coconut oil	-0.5	1.5	0.47	-0.6	1.8	0.54
	Palm oil	1.5	-5.1	2.68	1.8	-5.6	2.45
1985	Coconut oil	-1.2	1.4	0.23	-1.4	1.6	0.33
	Palm oil	1.4	-1.6	1.86	1.6	-1.8	1.74

/a The hypothesis of habit-formation cannot be rejected at the 95% confidence level.

Supply

28. The supply of palm oil is modeled using a vintage capital approach. 1/ As an oil palm tree matures, the oil yield of the tree rises from zero in the first three years to over 4.6 tons/hectare by year eight. The yield remains fairly stable for about nine years thereafter and then slowly begins to decline. As the tree reaches its mid-twenties, harvesting becomes more difficult as the tree grows taller. At some point, depending upon the cost of labor and the price of the oil, it becomes economically advantageous to replant the tree--at which point the yield drops to zero once more. By tracking cohorts of newly planted trees through this life cycle, a variable representing potential production can be calculated.

29. While the potential production variable can be considered the underlying capacity to produce, actual production differs from potential production for economic and biological reasons. On the economic side, input and output prices affect a producer's willingness to supply--although the

1/ See Akiyama, T. and P. Trivedi (1987).

immediate supply response is quite small. 1/ Biologically, the hybrid trees of Indonesia exhibit a cycle as well; high yields one year stress the trees and cause yields the following year to drop. To capture this effect, the lagged ratio of production to potential production is included as an explanatory variable.

30. As discussed earlier, area devoted to coconut production has expanded steadily with population. A simple linear trend explains 99% of the expansion in coconut area over the sample period, and attempts to introduce lagged price vectors to explain past investment decisions proved unfruitful. However, coconut production from planted area does respond to real prices through harvesting and marketing intensification. In the model, coconut production is a function of harvested area, lagged production, and real prices.

31. Once coconuts have been produced, they can be used as fresh nuts, or further processed into dried copra. When regulations allow, copra can be exported, or further crushed into meal and coconut oil. The fresh nuts can be used directly as food, or locally processed into kelentic oil. The demand for fresh fruit nuts is modeled as a function of the coconut oil price, real income, and the real price of rice. The amount of coconut production devoted to the formal copra sector is calculated as a residual, i.e., the difference

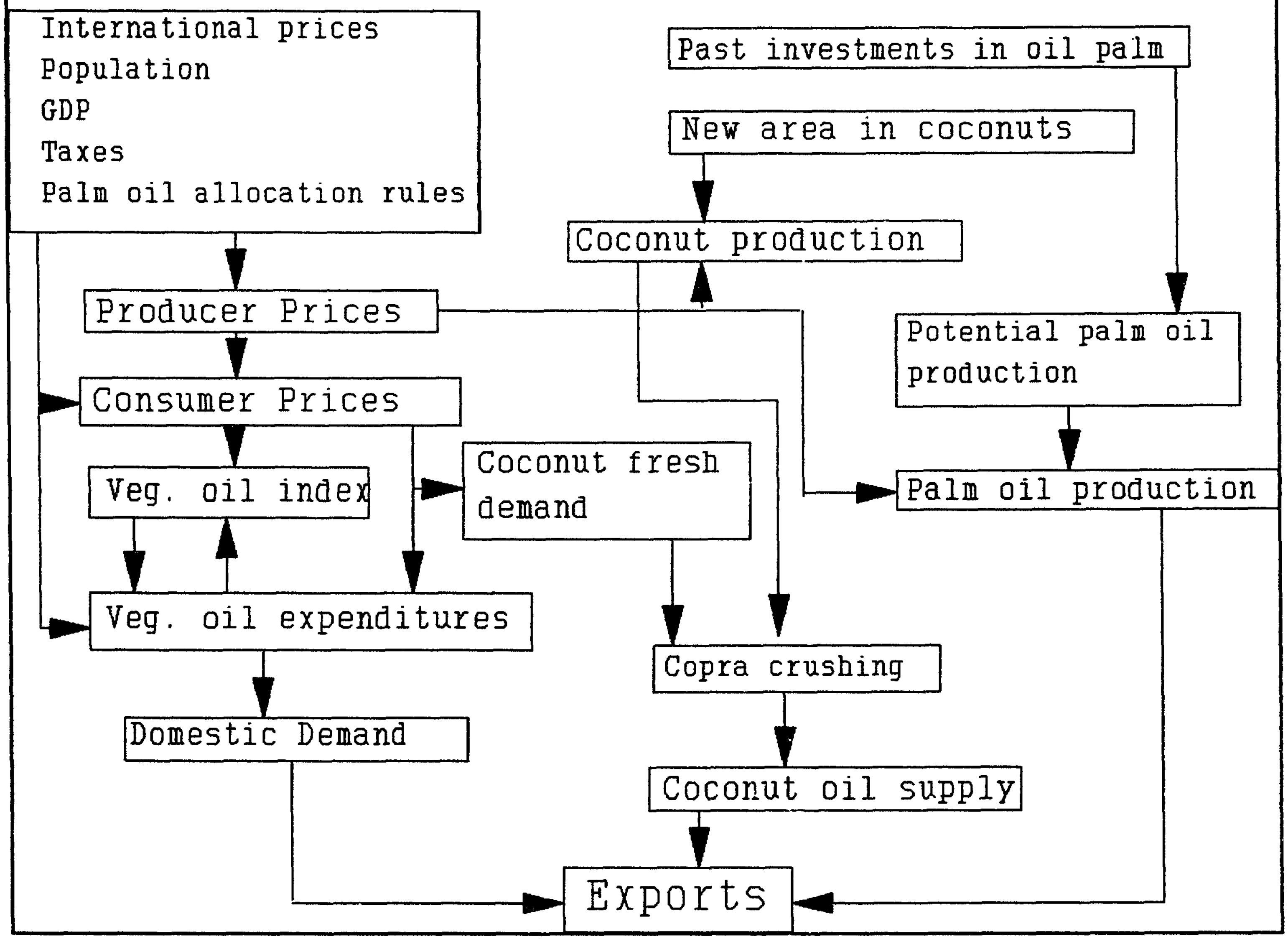
---

1/ Once a plantation is in operation, producers have little leeway in most of the production activities. Trees that are not maintained are subject to disease and certain minimal levels of fertilizer must be applied to assure future production. Harvested planting material is used to fuel processing plants so that energy costs are minimal as well. As a result, the high fixed costs and low variable costs provide a wide range over which producers will supply.

between coconut production (in copra equivalent) and fresh use (in copra equivalent). Since copra exports are limited by trade restrictions, most of the copra in the formal sector is converted into coconut oil, providing the model's supply of coconut oil.

32. Figure 6.1 shows the overall structure of the model and helps to illustrate some of the dynamics of the model behavior. While production decisions are bound by past investment decisions for coconut and oil palm trees and prices are dictated by world events, relative price changes do allow for a wide range of behavior in demand and marketing. On the demand side relative price changes alter both the allocation of expenditures between vegetable oils and other products and between palm oil and coconut oil. On the supply side palm oil production remains relatively insensitive to prices, but coconut prices do affect the allocation of supplied nuts to food/home consumption and to marketed copra supplies. Given the simultaneity of consumption and marketing responses in the domestic vegetable sector, it is important to look at the entire sector when gauging policy effects.

Figure 6.1: Model Flow Chart



VII. MODEL SCENARIOS AND SIMULATION RESULTS

33. In order to calculate the effects of certain policy changes as well as to quantify the revenues generated by a tax on vegetable oil exports which is under consideration, four policy scenarios were simulated using the model.

Base Scenario: Under this scenario, the current government policy of assessing domestic allocations from producers at set allocation prices below world market prices continues. Copra exports are still banned, but the recent policy of liberalizing coconut oil exports remains in place.

Base and Tax: Indonesian vegetable oil policies continue unchanged. In addition an export tax of 5% is imposed on vegetable oil exports.

World + Tax: Under this scenario, Indonesia dismantles its vegetable oil allocation system, and allows unlimited export of both crude and refined vegetable oils. Farm gate prices rise to international levels minus transportation costs--about 25% above the baseline scenario prices. At the same time, however, the government imposes a 5% export tax on the oils.

World Prices: Under the final scenario, trade is fully liberalized without export taxes. Domestic prices now equal international prices minus transportation costs.

34. In examining the results of the model under the four scenarios, one result which quickly becomes obvious is that the demand and supply of vegetable oils in Indonesia have a momentum which is difficult to redirect. While demand (Table 7.1) is responsive to prices, population growth and income changes are extremely important determinants as well. Stocks of existing trees mature over a period of several years and have lives spanning decades. Investments made today have minimal effect until the last half of the 1990s. Supplies (Table 7.2) of palm oil and coconuts do respond to prices, but these responses are slow to develop and are limited by the underlying productive capacity of the mature tree stock.

35. The supply response of palm oil under the four scenarios is straight forward. The price responsiveness in the short-run is positive, but small. As farm-gate prices rise from the Baseline scenario to the Export-tax scenario, and finally to the world price scenario, supplies of palm oil increase as more inputs are used and harvesting becomes more intensive in response to greater profitability. At the same time, however, investment decisions from previous decades have dictated a potential limit to these increases. The supply response of coconut oil is similar in direction and scale, but contains a larger degree of simultaneity. While palm oil is quickly processed once the fruit matures and before it spoils; with coconut production there is an alternative use which competes for mature nuts. Harvested nuts can be retained locally or sold to processors. One option for home consumption is the production of kelentic oil, which serves as an alternative to refined coconut oil. As the price of coconut oil increases, a larger number of nuts are retained locally (Table 7.3), leaving a reduced

Table 7.1: INDONESIAN VEGETABLE OILS: DOMESTIC DEMAND, HISTORIC 1987-1988, SIMULATED 1989-2000

Year	Domestic Demand CPO				Domestic Demand CCO			
	Scenario				Scenario			
	Baseline	Base + Tax	World + Tax	World Price	Baseline	Base + Tax	World + Tax	World Price
	(000 mt)							
1987	856	856.00	856.00	856.00	616.00	616.00	616.00	616.00
1988	924	924.00	924.00	924.00	591.00	591.00	591.00	591.00
1989	816	824.24	799.70	793.51	697.09	696.99	690.84	690.91
1990	954	963.51	936.51	929.58	694.23	693.85	687.73	688.01
1991	1,067	1,077.19	1,046.41	1,038.85	717.86	717.31	711.99	712.38
1992	1,186	1,197.61	1,162.49	1,154.25	744.66	743.92	739.59	740.11
1993	1,321	1,333.39	1,293.60	1,284.61	768.72	767.76	764.51	765.19
1994	1,449	1,462.36	1,418.06	1,408.38	781.39	780.19	778.22	779.06
1995	1,588	1,601.96	1,552.72	1,542.29	794.01	792.54	792.02	793.06
1996	1,754	1,769.51	1,715.29	1,703.98	795.55	793.73	794.59	795.87
1997	1,937	1,953.79	1,894.17	1,881.91	792.20	789.99	792.40	793.96
1998	2,136	2,154.30	2,088.81	2,075.51	785.12	782.47	786.65	788.52
1999	2,353	2,372.59	2,300.59	2,286.17	773.76	770.63	776.80	779.02
2000	2,597	2,618.90	2,539.81	2,524.12	759.46	775.76	764.21	766.82

Notes: CPO - palm oil; CCO - coconut oil.

Table 7.2: INDONESIAN VEGETABLE OILS: DOMESTIC SUPPLIES, HISTORIC 1987-1988, SIMULATED 1989-2000

Year	Production CPO				Production CCO			
	Scenario				Scenario			
	Baseline	Base + Tax	World + Tax	World Price	Baseline	Base + Tax	World + Tax	World Price
	('000 mt)							
1987	1,465	1,465	1,465	1,465	1,465	754	754	754
1988	1,698	1,698	1,698	1,698	1,698	803	803	803
1989	2,261	2,261	2,257	2,270	2,273	804	826	831
1990	2,491	2,491	2,488	2,500	2,502	872	893	898
1991	2,693	2,693	2,690	2,701	2,703	887	925	933
1992	2,835	2,835	2,832	2,843	2,845	935	969	978
1993	2,953	2,953	2,950	2,960	2,962	958	1,002	1,011
1994	3,069	3,069	3,067	3,076	3,089	999	1,042	1,052
1995	3,164	3,164	3,162	3,171	3,172	1,028	1,077	1,088
1996	3,244	3,244	3,241	3,250	3,252	1,067	1,117	1,128
1997	3,314	3,314	3,312	3,321	3,322	1,099	1,154	1,166
1998	3,384	3,384	3,382	3,390	3,391	1,136	1,191	1,203
1999	3,442	3,442	3,440	3,448	3,449	1,167	1,226	1,238
2000	3,493	3,493	3,491	3,499	3,500	1,202	1,262	1,275

Table 7.3: COCONUT PRODUCTION AND USE: HISTORIC 1987-1988, SIMULATED 1988-2000

(Copra Equivalents)

Year	Production Coconuts (Copra Eq.)				Coconuts, other use				Copra Crush			
	Scenario				Scenario				Scenario			
	Baseline	Base + Tax	World + Tax	World Price	Baseline	Base + Tax	World + Tax	World Price	Baseline	Base + Tax	World + Tax	World Price
1987	2,009	2,009	2,009	2,009	772	772	772	722	1,237	1,237	1,237	1,237
1988	1,974	1,969	1,987	1,991	724	715	750	757	1,317	1,317	1,317	1,317
1989	2,038	2,029	2,068	2,077	788	787	792	793	1,250	1,242	1,276	1,284
1990	2,123	2,109	2,167	2,179	769	763	787	791	1,353	1,347	1,379	1,388
1991	2,192	2,176	2,242	2,257	808	806	814	815	1,384	1,371	1,429	1,442
1992	2,258	2,241	2,313	2,329	802	797	815	818	1,456	1,444	1,498	1,511
1993	2,322	2,305	2,381	2,398	827	825	833	835	1,495	1,480	1,548	1,563
1994	2,386	2,368	2,448	2,466	827	824	838	840	1,559	1,544	1,611	1,626
1995	2,450	2,431	2,515	2,534	844	842	851	852	1,605	1,589	1,664	1,681
1996	2,513	2,493	2,582	2,601	847	844	855	857	1,666	1,650	1,727	1,744
1997	2,577	2,556	2,648	2,668	859	857	865	866	1,718	1,699	1,783	1,802
1998	2,637	2,616	2,711	2,731	863	860	870	871	1,774	1,755	1,841	1,860
1999	2,696	2,674	2,772	2,793	872	870	877	879	1,824	1,804	1,895	1,914
2000	2,755	2,733	2,832	2,854	876	874	882	883	1,878	1,858	1,950	1,971

amount of copra available for crushing. As a result, the supply response of coconut oil is more muted than the overall supply response of coconuts. With significant levels of price increases, the overwhelming production increases allow an increase in both local consumption and copra crushing; small price increases could conceivably lead to a decline in coconut oil supplies.

36. As noted earlier, policies in Indonesia have been effective in lowering farm-gate prices for producers, thereby guaranteeing low input costs to processors; but at the same time recent consumer prices have ranged above prices of comparable vegetable oils in Europe. The large margin between farm-gate and consumer prices implies either inefficiencies or abnormally large profits in the processing and distribution network. In either case, allowing farm-gate prices to rise to near-world-level prices would do little to decrease the margin. Therefore, it is assumed under the model simulation, that increased costs to the processors will be passed on to consumers.

37. On the supply side, the production of palm oil is entrenched by past events, while coconut oil supplies are more sensitive to prices due to alternative uses for the fresh coconuts. On the demand side, it is the consumption of palm oil which appears more price sensitive. As prices fall, consumers are encouraged to consider both coconut oil and palm oil; however, there is a secondary effect as well. For a given level of expenditures, more total oil is affordable; that is, the consumer has suffered the equivalent of an income loss. Palm oil, the more income elastic of the two, is disproportionately influenced by the secondary effect, reinforcing the initial price-effect. This can best be seen with relatively small price changes.

Imposing a 5% export tax lessens domestic prices by a comparable amount since traders would receive an equal profit by selling domestically or by exporting only if the price spread between domestic and export prices equalled the export tax. Imposing an export tax on the base line (and therefore reducing domestic prices by 5%) causes domestic CPO consumption to jump 21,000 tons by the year 2000; imposing an export tax on the world price scenario causes CPO consumption to increase by 15,800 tons by 2000.

38. Tables 7.4 to 7.6 provide the commodity-detailed results for trade under the four scenarios (Table 7.8 provides summary results for 1995 and 2000). Trade liberalization works to dampen demand and stimulate supply, resulting in substantial gains in export revenue. Moving from the Baseline to World-Price scenarios increases export revenues by $65 million in 1995 and $95 million in 2000. Liberalization plus taxation essentially negate these gains as export revenues under the World + Tax scenario are quite close to the Baseline scenario.

39. Table 7.7 shows tax revenues generated under the two tax scenarios. (These are summarized for 1995 and 2000 in Table 7.8). While generating $53 million in tax revenue, adding an export tax to the Baseline scenario also results in a $70 million drop in export revenues in 1995; this scheme generates $47 million in tax revenue in 2000 but leads to a $70 million decline in export revenues in that year. Under a trade liberalization with export tax scheme $57 million and $52 million are generated for the government in 1995 and 2000, respectively; however, export revenues decline by $71 million in each year. Since the Government of Indonesia, through its PTPs

Table 7.4: COCONUT EXPORTS: HISTORIC 1987-88, SIMULATED 1989-2000

	Export Quantity CCO				Export $ Value CCO			
	Scenario							
Year	Baseline	Base + Tax	World + Tax	World Price	Baseline	Base + Tax	World + Tax	World Price
	('000 mt)				(US$ 1985 constant)			
1987	118	118	118	118	49,796	47,306	47,306	49,796
1988	226	226	226	226	126,560	120,232	120,232	126,560
1989	112	107	135	140	65,004	58,885	74,193	81,109
1990	182	178	205	210	110,602	102,711	118,478	127,949
1991	178	170	213	221	113,178	102,720	128,472	140,418
1992	198	191	230	237	131,171	120,314	144,946	157,694
1993	199	190	237	246	137,912	125,228	156,063	170,630
1994	227	219	264	273	163,607	149,811	180,585	196,559
1995	245	235	285	295	183,336	167,500	202,732	220,816
1996	283	274	323	332	215,928	198,545	234,092	253,953
1997	319	309	361	372	248,990	229,330	267,835	290,078
1998	363	353	404	415	288,633	267,060	305,806	330,151
1999	406	397	449	459	329,673	305,789	345,907	372,668
2000	456	446	497	508	376,834	350,719	390,758	419,920

Table 7.5: PALM OIL EXPORTS

	Export Quantity COP				Export $ Value COP			
	Scenario							
Year	Baseline	Base + Tax	World + Tax	World Price	Baseline	Base + Tax	World + Tax	World Price
	('000 mt)				('000 US$ 1985 constant)			
1987	531	531	531	531	170,982	162,433	162,433	170,982
1998	692	692	692	692	307,248	291,886	291,886	307,248
1989	1,445	1,433	1,470	1,479	608,429	573,179	588,018	622,679
1990	1,537	1,524	1,564	1,573	654,807	616,895	632,758	670,036
1991	1,626	1,611	1,654	1,664	734,864	692,368	710,386	752,189
1992	1,649	1,635	1,680	1,691	793,732	747,573	768,442	813,847
1993	1,632	1,617	1,667	1,678	833,311	784,348	808,519	856,660
1994	1,620	1,604	1,658	1,670	874,524	822,664	850,287	901,260
1995	1,576	1,560	1,618	1,630	901,688	847,480	879,224	932,470
1996	1,490	1,472	1,535	1,548	875,636	821,856	857,068	909,812
1997	1,378	1,358	1,427	1,440	831,462	778,914	817,997	869,426
198	1,248	1,227	1,301	1,316	772,907	722,207	765,580	815,069
1999	1,090	1,068	1,147	1,163	692,053	644,195	692,372	738,920
2000	896	872	959	976	583,034	539,253	592,939	635,297

Table 7.6: TOTAL EXPORT REVENUE: HISTORIC 1987-88, SIMULATED 1989-2000

	Total Export Revenue			
	Scenario			
Year	Baseline	Base + Tax	World + Tax	World Price
	('000 US$ 1985 constant)			
1987	220,778	209,739	209,739	220,778
1988	433,808	412,118	412,118	433,808
1989	673,433	632,064	662,211	703,787
1990	765,409	719,606	719,236	797,985
1991	848,042	795,089	838,858	892,607
1992	924,902	867,887	913,389	971,541
1993	971,223	909,576	964,582	1,027,289
1994	1,038,131	972,474	1,030,872	1,097,818
1995	1,085,024	1,014,980	1,081,956	1,153,286
1996	1,091,564	1,020,401	1,091,160	1,163,765
1997	1,080,452	1,008,244	1,085,832	1,159,505
1998	1,061,540	989,267	1,071,386	1,145,220
1999	1,021,726	949,984	1,038,279	1,111,588
2000	959,868	889,972	983,697	1,055,218

Table 7.7: TAX REVENUES GENERATED BY VEGETABLE OIL EXPORT TAX

('000 US$ 1985 constant)

	Tax Revenue CPO		Tax Revenue CCO		Total Revenues from Vegetable Oil Export Tax	
	Scenario					
Year	Base + Tax	World + Tax	Base + Tax	World + Tax	Base + Tax	World + Tax
1987	8,549	8,549	2,490	2,490	11,039	11,039
1988	15,362	15,362	6,328	6,328	21,690	21,690
1989	30,167	30,948	3,099	3,905	33,267	34,853
1990	32,468	33,303	5,406	6,236	37,874	39,539
1991	36,440	37,389	5,406	6,762	41,847	44,150
1992	39,346	40,444	6,332	7,629	45,678	48,073
1993	41,281	42,554	6,591	8,214	47,872	50,767
1994	43,298	44,752	7,885	9,504	51,183	54,256
1995	44,604	46,275	8,816	10,670	53,420	56,945
1996	43,256	45,109	10,450	12,321	53,705	57,429
1997	40,995	43,052	12,070	14,097	53,065	57,149
1998	38,011	40,294	14,056	16,095	52,067	56,389
1999	33,905	36,441	16,094	18,206	49,999	54,646
2000	28,382	31,207	18,459	20,566	46,841	51,774

Table 7.8: SUMMARY OF TOTAL EXPORT REVENUE AND GOVERNMENT REVENUE FOR 1995 AND 2000

	Export Revenue				Government Revenue	
Year	Baseline	World Price	Baseline and Tax	World and Tax	Baseline and Tax	World and Tax
			(million 1985 $US)			
1995	1,085	1,153	1,015	1,082	53	57
2000	960	1,055	890	984	47	52

and PNP's, is a major producer of palm oil, a portion of the lost export revenues also comes out of government coffers. Hence, not only would an export tax prove relatively costly in terms of lost export revenue, part of the "gains" in terms of government revenues would come from other government institutions.

Implications for Vegetable Oil Milling

40. Total copra milling capacity has remained fairly constant in Indonesia over the past decade, although ownership of milling capacity has become more concentrated. In 1977, 415 firms had an estimated capacity of 1.66 million tons (copra). In 1985, 333 firms owned 1.98 million of capacity. In 1975, firms averaged a 51% utilization rate. In 1985, the last year for which data is available, the industry averaged a 45% utilization rate. Firms have an incentive to both over-invest (thereby increasing processing costs) and to overstate their potential capacity, however, for the following reasons. Licenses are needed in order to expand existing plants or to build new plants. In reviewing proposed expansions, the Ministry of Industry looks at existing capacity and future needs. By over-investing, existing firms prevent the establishment of new competing firms; by overstating their capacity, the firms accomplish the same goal without costs.

41. While the location of existing milling plants is not ideal, there appears to be little need for increasing capacity. Under all three scenarios, copra crushings remain under 1.9 million tons. In the near term, excess capacity will remain near current levels.

42. In 1982, 25 plants milled palm oil with a collective capacity of 794 tons of fresh fruit bunches per hour. By 1987, capacity had grown to 2,130 tons per hour. Even assuming an optimistic extraction rate of 20% for oil, and plant operations of 450 hours/month, existing capacity translates into 1.9 million tons of palm oil. In addition, since the acid content of the ffb's climbs quickly within 24 hours of harvesting, inter-shipments of ffb's among processors is usually not feasible, nor can processing be delayed during peak production months. Production of CPO in Indonesia will problably exceed two million tons in 1989. The need for rapid expansion of CPO milling plants is crucial and the possibility of local shortages in milling capacity are real. At least one government estate is currently shipping ffb's over 60 kilometers of bad roads because of lack of adequate milling. Ten more milling plants with a total capacity of 300 ffb tons/hour are scheduled for completion in 1988/89, five of which are supported by World Bank and ADB loans. During Repelita V which ends in 1994, an additional 34 milling plants with 1,030 tons of capacity are scheduled for construction. This does not include new private milling capacity for either existing estates, or estates started under the Pir-Trans scheme.

43. The need for rapid expansion of milling capacity is well understood in Indonesia, and the schedule of new plant construction addresses the problem. At the same time, however, new milling plants require one or two years to construct in Indonesia, and government and PTP resources are currently quite stretched. Slippage in meeting the construction schedule would result in local capacity shortages by the early 1990s and the potential waste of production gains by existing oil palm plantings.

VIII. CONCLUSIONS

44. The production and consumption of vegetable oils in Indonesia have been growing rapidly and will continue to grow rapidly through the end of the century. Domestic demand, driven by income and population growth is projected to increase from 856,000 tons of CPO and 616,000 tons of CCO in 1987, to 2.6 million tons of CPO and 760,000 tons of CCO in 2000. Production will expand rapidly as well, with CPO production growing from 1.5 million tons in 1987 to 3.5 million tons in 2000. Coconut oil production will grow as well, from 754,000 tons in 1987 to 1.2 million tons in 2000. Past gains have come amid a complex collection of government interventions in the vegetable oils market, which have both encouraged production through direct investment in palm oil and indirect assistance to the private sector, and discouraged production through a system of allocation prices which lower average farm-gate receipts. Consumers do not appear to have benefited from lowered farm-gate prices, with most of the benefits going to processors and distributors. Policy simulations show that removing such cumbersome regulations would stimulate production, but would not guarantee consumer benefits. Regardless of the policy scenario evaluated, past investments in tree crops guarantee rapid future production expansion. However, this increased production will not confer market-making power on Indonesian producers, since as tree-crop producers, they are unable to adjust supplies quickly as do suppliers of vegetable oil from annual crops. The rapid expansion of vegetable oil may precipitate a domestic crisis in the palm oil milling industry. While current

excess capacity for copra milling can easily absorb the projected production gains, palm oil milling capacity is stretched. New investments in milling are planned by the private sector and the Ministry of Industry. Should the investments fail to materialize, some future production gains from existing trees will be squandered.

45. In a country with a developing infrastructure and large social needs, government financing issues take on special significance. However, the results of the model demonstrate that an export tax on vegetable oils would prove quite costly in terms of export revenues, with tax revenue gains of $50-60 million annually resulting in substantially larger drops in export revenues. In addition, a portion of the gains in tax revenues will come at the expense of revenues generated by state-owned estates, essentially transferring revenues from one government institution to another and reducing further the gains from an export tax.

Annex A: Palm Oil and the Larger Market for Vegetable Oils

46. Generally speaking, any vegetable oil can be used in cooking and, therefore, the potential for a wide range of substitution exists. However, vegetable oils in their natural state have a number of unique characteristics, such as flavor, aroma, the smoking-point of the oil, and dietary differences in vitamin and saturated-fat content. Consumption of pure vegetable oils is often heavily influenced by traditional cooking techniques and cuisine which necessarily increases the differentiation among vegetable oils. At the same time, a great deal of vegetable oil consumption comes in a more highly processed form, and it is at this level that substitution possibilities abound. Chemically, different vegetable oils are distinguished primarily by the dominant type of fatty-acid contained in the oil. The chemical composition determines physical characteristics such as smelting and smoking points. Saturated fats tend to have a higher melting point and are naturally solid at room temperature. Lauric oils have a "sudsing" capacity and are often used in detergents, shampoos and soaps. However, all vegetable oils are in fact composed of several fatty-acids and, when processed, these fatty-acid chains can be separated and or otherwise altered to yield building blocks for processed products. For example, soybean oil, which is normally liquid at room temperature, can be hydrogenated and combined with other products to yield either margarine, a butter substitute, or vanaspati, a lard substitute--both of which are solid at room temperature. Sometimes, as in the case in margarine production, the chemical structure of the oil is altered, while in other cases, the changes are cosmetic. Palm oil, which is naturally a bright

orange, is routinely bleached and deodorized. Many products can be made from a variety of vegetable oil sources using different chemical recipes, but yielding products which are indistinguishable in terms of taste, color, aroma, and other cooking characteristics.

47. This high level of technically-feasible substitution appears economically feasible as well--that is, while there are costs associated with "recipe-changing", processors will switch formulas as market prices change. The strongest evidence for this economic-substitution is given by the high level of correlation among prices (Table A.1). Recalling from Table 2.1 the tremendous variety in vegetable oil sources, it is easy to see how differing supply shocks can enter the vegetable oil market independently. Agricultural policy changes in North America are most likely independent of rainfall in Malaysia, or exchange rate policy in Brazil, and yet, despite the variety and evolution of supply conditions in the world, prices among vegetable oils remain highly correlated, indicating that substitution in demand largely compensates for shocks to supply. It is interesting to note that the correlation between coconut oil and palm kernel oil, which have similar demand characteristics, is greater than that between palm oil and palm kernel oil which are contained in the same fruit.

48. Even if the market were more limited, giving Indonesia a significant market share, producers or their agents would have a difficult time exercising any monopoly power. Indonesia produces its vegetable oils from tree crops in a market dominated by annual crops. Except through short-term stock buildup, the only feasible adjustment is through planting new trees--which begin to

Table A.1: PEARSON CORRELATION COEFFICIENTS FOR SELECTED VEGETABLE OIL PRICES

	Soy Oil	Palm Oil	Coconut Oil	Rapeseed Oil	Groundnut Oil	Palm Kernel Oil
Soy Oil	1.00	0.96	0.87	0.99	0.95	0.91
Palm Oil	1.96	1.00	0.91	0.97	0.95	0.95
Coconut Oil	0.87	0.91	1.00	0.88	0.80	0.99
Rapeseed Oil	0.99	0.97	0.88	1.00	0.95	0.92
Groundnut Oil	0.95	0.95	0.80	0.95	1.00	0.86
Palm Kernel Oil	0.91	0.95	0.99	0.92	0.86	1.00

Note: Prices are C.I.F. Rotterdam, 1960-1988. All coefficients were significant at a 99% confidence level.

produce after four years--or by slowly depreciating existing stands of trees. Adjustments in annual crop production can occur within a year on an overwhelming scale. Even weather-related or other natural events would most likely swamp adjustments from Indonesia. For example, in 1988, a drought in North America caused US soybean production to drop by nearly 11 million tons which was equivalent to a 2.26 million ton decline in world vegetable oil supplies--more than one-and-a-half times Indonesia's annual palm oil production.

49. The World Bank's multi-country model of the vegetable oil sector was used to validate the notion of Indonesia as a price taker in the world vegetable oil market. 1/ Initial model results were compared to a simulation in which Indonesia's potential palm oil and coconut oil production was increased by 33%. As can be seen in Table A.2, the impact of extremely large changes in domestic production in Indonesia quickly become dispersed and muted in a global context. In fact, the table conveys a false sense of accuracy given the small impact of the scenario change, as none of the reported changes were significantly different from zero given the forecasting error associated with the projections.

1/ The multi-country model is described in "A Global Vegetable Oils and Meals Model", currently in draft form.

Table A.2: IMPACT OF 33% INCREASE IN PALM OIL AND COCONUT OIL PRODUCTION IN INDONESIA

(% change)

Year	Real Price: Palm Oil	Real Price: Coconut Oil	Real Price: Soybean
1990	-0.02	0.00	-0.01
1995	-0.98	-0.01	0.00
2000	-3.10	-0.88	-0.40
	Production: Malaysian Palm Oil	**Production: World Coconut Oil**	**Production: World Soybean**
1990	0.00	0.00	0.0
1995	-0.02	-.002	0.0
2000	-11.40	-0.340	-0.59

Annex B: The Almost Ideal Demand System

50. Deaton and Muellbauer's Almost Ideal Demand System begins with the following expenditure function:

$$\log c(u, p) = a(p) + ub(p) \tag{1}$$

where,

$$a(p) = \alpha_o + \sum_k \alpha k \log p_k + \tfrac{1}{2} \sum_k \sum_m \gamma_{km} \log p_k \log p_m , \tag{2}$$

$$b(p) = \beta_o \, \pi_k \, p^{\beta} k, \tag{3}$$

pk are prices, u is utility and α, β and γ^* are parameters.

51. Substituting (2) and (3) into (1) and noting that $\partial \log c / \partial \log p_i = w_i$ the expenditure share is given by

$$w_i = \alpha_i + \sum_j \gamma_{ij} \log p_j + \beta_i \log (x/P) \tag{4}$$

where P is the price index:

$$\log P = \alpha_o + \Sigma\alpha_k \log p_k + \tfrac{1}{2} \sum_k \sum_m \gamma_{km} \log p_k \log p_m \tag{5}$$

Alternatively the price index can be approximated using Stone's index:

$$\log P = \Sigma w_i \log (p_i) \tag{6}$$

Using (4) and (6), theoretical restructures can be applied in the following way:

Adding up requires, for all j,

$$\Sigma \alpha_k = 1, \Sigma_k \beta_k = 0, \Sigma_k \gamma_{kj} = 0. \tag{7}$$

Homogeneity is satisfied if and only if, for all j,

$$\Sigma_k \gamma_{jk} = 0, \tag{8}$$

while symmetry is satisfied provided

$$\gamma_{ij} = \gamma_{ji}. \tag{9}$$

Manser (1976) provides a test for habit formation. Let

$$a_i = \alpha_i + d_i q_{it-1}, \tag{10}$$

where q is per capita consumption of good i, and α_i, d_i are parameters. Substituting (10) into (4) yields the habit-model. Imposing the adding-up condition on the resulting habit model requires.

$$\Sigma (a_i + d_i) = 1 \tag{11}$$

Annex Table C1: LISTING OF MODEL, PARAMETER ESTIMATES AND TEST STATISTICS

```
TXCAP=EXP(LTXCAP) ;
FRNUT=960-EXP(DIFNUT) ;
PCPO=PCPOR*EXRATE/1000+DIFCPO ;
PCCO=PCCOR*EXRATE/1000+DIFCCO ;
PCOPJ=PRCOPR*EXRATE/1000+DIFCOP ;
RPCOP=PCOPJ/CPI ;
PDCPO=-EXP(LLPDCPO)+5000 ;
RPCPO=PCPO/CPI*100 ;
RPCCO=PCCO/CPI*100 ;
EXQCCO=PDCCO-DUCCO+IMQCCO-ERRCCO+BSCCO-ESCCO ;
COPCR=PDCCN;
EXQCPO=PDCPO-DUCPO+IMQCPO-ERRCPO+BSCPO-ESCPO ;
DUCCO=SHCCO*TXCAP/RPCCO*POP ;
DUCPO=SHCPO*TXCAP/RPCPO*POP ;
PSTAR=LOG(RPCCO)*SHCCO+LOG(RPCPO)*SHCPO ;
TEXP=TXCAP*POP ;

SHCCO=A1+G1_1*LOG(RPCCO)+(0-G1_1)*LOG(RPCPO)+B1*(LOG(TXCAP)-PSTAR);
      G1_1: -0.06331(-1.1)  A1: 1.67(16.85)  B1: -0.5119(-8.32)

SHCPO=(1-A1)+(0-G1_1)*LOG(RPCCO)+G2_2*LOG(RPCPO)+(0-B1)* (LOG(TXCAP)-PSTAR);
      A1: 1.67(16.85)  G1_1: -0.06331(-1.1)  G2_2: -0.06333(-1.1)  B1: -0.5119(-8.32)

PDCCO=PDCO_0+PDCO_1+COPCR;
      PDCO_1: 0.6396(17.7)  PDCO_0: -32.2(-0.93)

LLPDCOP=PDCP_0+PDCP_1*(PPOT)+PDCP_2*(LAG(LLPDCPO/PPOT)) +PDCP_3*LAG2(LOG(RPCPO));
       PDCP_1: -0.0003373(-14.27) PDCP_0:8.641(194.46)  PDCP_2: -0.06118(-0.1) PDCP_3: -0.02238(-2.52)

PDCCN=PDCC_0+PDCC_1*HACOP+PDCC_2*LAG2(RPCCO)+PDCC_3*LAG(PDCCN);
      PDCC_1: 0.3821(3.68)  PDCC_0: 168.7(0.68)  PDCC_2: 1.4(1.21)  PDCC_3: 0.2176(0.91)

DIFNUT=DIFN_0+DIFN_1*LOG(RPCCO)+DIFN_2*LOG(RPRICE)+DIFN_3* LOG(RYCAP)+DIFN_4*LAG(DIFNUT)+DIFN_5*D1;
       DIFN_1: -0.2623(-0.43)  DIFN_0: 4.349(1.7)  DIFN_2: 0.6575(0.68)  DIFN_3: -2.888(-4.58)
       DIFN_4: -0.809(-10.33)  DIFN_5: -3.969(-10.81)

LTXCAP=TX0+TX1+LOG(RPRICE)+TX2*PSTAR+TX3*LOG(RYCAP);
       TX1: -0.4797(-2.03)  TX0: 6.296(9.19)  TX2: 0.9169(6.62)  TX3: 1.483(9.09)

HACOP=HACO+HAC1*YEAR;
      HAC1: 91.24(51.5)  HACO: -177989(-50.77)
```

Annex Table C2: MODEL SUMMARY STATISTICS; NONLINEAR SUR SUMMARY OF RESIDUAL ERRORS

Equation	Degree of Freedom Model	Degree of Freedom Error	SSE	MSE	Root MSE	R-Square	Label
SHCPO	2.5	11.5	0.04267	.00371036	0.06091	0.8677	Expenditure share, CPO
SHCCO	1.5	12.5	0.04266	.00341312	0.05842	0.8677	Expenditure share, CCO
PDCCO	2	12	9606.51	800.54	28.29386	0.9137	Production CCO ('000 tons)
LLPDCPO	4	10	.00047438	4.74E-05	0.0068875	0.9935	Log of production COP variable
DIFNUT	6	8	0.83206	0.10401	0.32250	0.9639	Log of fresh use variable, coconuts
LTXCAP	4	10	0.08385	.00838458	0.09157	0.8656	Log total oil expenditures per capita
PDCCN	4	10	56339.12	5633.91	75.05939	0.8846	Production coconuts (copra eq. '000 ton)
HACOP	2	12	15170.49	1264.21	35.55570	0.9918	Area copra ('000 ha)

Annex Table C.3: NON-LINEAR SUR PARAMETER ESTIMATES

Parameter	Estimate	Approximate STD Error	"T" Ratio	Approximate Prob>[T]
A1	1.66961	0.09907	16.85	0.0001
PDCO_0	-32.20385	34.69638	-0.93	0.3716
PDCO_1	0.63964	0.03615	17.70	0.0001
PDCP_0	8.64081	0.04444	194.46	0.0001
PDCP_1	-3.37E-04	2.36E-05	-14.27	0.0001
PDCP_2	-0.06118	0.62815	-0.10	0.9243
PDCP_3	-0.02238	0.0088682	-2.52	0.0302
PDCC_0	168.74	247.87	0.68	0.5115
PDCC_1	0.38214	0.10392	3.68	0.0043
PDCC_2	1.39983	1.15591	1.21	0.2537
PDCC_3	0.21764	0.24043	0.91	0.3866
G1_1	-0.06331	0.05764	-1.10	0.2936
B1	-0.51195	0.06151	-8.32	0.0001
DIFN_0	4.34948	2.55968	1.70	0.1277
DIFN_1	-0.26228	0.60695	-0.43	0.6771
DIFN_2	0.65751	0.97202	0.68	0.5178
DIFN_3	-2.88800	0.63010	-4.58	0.0018
DIFN_4	-0.80899	0.07829	-10.33	0.0001
DIFN_5	-3.96920	0.36715	-10.81	0.0001
G2_2	-0.06333	0.05764	-1.10	0.2954
TX0	6.68496	0.68496	9.19	0.0001
TX1	-0.47974	0.23660	-2.03	0.0701
TX2	0.91692	0.13854	6.62	0.0001
TX3	1.48341	0.16311	9.09	0.0001
HAC0	-177989	3505.65	-50.77	0.0001
HAC1	91.24258	1.77185	51.50	0.0001

Annex Table C4: DESCRIPTIVE STATISTICS FOR MODEL VALIDATION; ACTUAL AND DYNAMIC SIMULATION RESULTS

Variable	NOBS	N	ACTUAL MEAN	ACTUAL STD	PREDICTED MEAN	PREDICTED STD	LABEL
EXQCCO	14	14	28.0357	49.3738	17.9611	37.2069	Export quantity cco
FRNUT	14	14	629.5	153.0	645.4	139.4	Fresh nut use, copra eq.
EXQCPO	14	14	334.9	113.2	338.2	163.1	Export quantity cpo
DUCCO	14	14	546.8	81.5090	547.6	62.8039	Domestic util. cco
DUCPO	14	14	283.1	286.3	279.8	271.8	Domestic util. cpo
PSTAR1	14	14	4.1747	0.2299	4.1759	0.2326	Aggregate price index, oils
TEXP	14	14	51916.7	15491.4	51953.3	15163.7	Total expenditures on veg. oil
PCCO	14	14	341.7	212.1	341.7	212.1	Domestic retail price cco Rp/kilo
PCPO	14	14	251.1	98.0566	251.1	98.0566	Domestic price cpo in Rp.
RPCPO	14	14	59.5992	21.7955	59.5992	21.7955	Deflated cpo price (world)
RPCCO	14	14	72.1345	17.6411	72.1345	17.6411	Deflated cco price (world)
PCOPJ	14	14	234.2	118.2	234.2	118.2	Price copra Java'(nom. Rps)
PDCPO	14	14	651.1	319.9	650.9	320.7	Production palm oil ('000 tons)
TXCAP	14	14	368.9	81.5856	369.7	82.2421	Total veg. oil expend/cap
COPCR	14	14	936.7	137.0	922.5	86.1624	Copra crush
RPCOP	14	14	0.5210	0.1590	0.5210	0.1590	Real price copra, S. Sulawesi
PDCCN	14	14	1566.2	193.8	1567.9	172.5	Production coconuts (copra eq.)
LLPDCPO	14	14	8.3751	0.0752	8.3751	0.0755	Log of production cop variable
PDCCO	14	14	567.0	92.5518	557.8	55.1129	Production cco ('000 tons)
SHCCO	14	14	0.7778	0.1575	0.7784	0.1437	Expenditure share cco
SHCPO	14	14	0.2222	0.1575	0.2215	0.1437	Expenditure share cpo
LTXCAP	14	14	5.8883	0.2190	5.8898	0.222	Log total oil expenditures/cap
DIFNUT	14	14	5.4574	1.3314	5.4526	1.2226	Log of fresh coconut use variable
HACOP	14	14	2534.6	377.6	2534.8	381.7	Area copra ('000 ha)

Annex Table C5: VALIDATION STATISTICS FOR DYNAMIC MODEL SIMULATION, 1972-1985

Variable	N	MSE DECOMPOSITION PROPORTIONS BIAS (UM)	REG (UR)	DIST (UD)	VAR (UC)	COVAR	INEQUALITY COEF U1	U	LABEL
EXQCCO	14	0.022	0.529	0.449	0.030	0.948	1.2321	0.7138	export quantity CCO
FRNUT	14	0.036	0.019	0.945	0.024	0.940	0.1301	0.0644	Fresh nut use, copra, eq.
EXQCPO	14	0.002	0.598	0.401	0.389	0.609	0.2188	0.1063	Export quantity CPO
DUCCO	14	0.000	0.001	0.999	0.119	0.881	0.0945	0.0473	Domestic util. CCO
DUCPO	14	0.003	0.008	0.990	0.044	0.954	0.1695	0.0861	Domestic util. CPO
PSTAR	14	0.007	0.051	0.942	0.038	0.954	0.0033	0.0016	Aggregate price index, oils
TEXP	14	0.000	0.001	0.999	0.008	0.992	0.0662	0.0331	Aggregate oil expenditures
PDCPO	14	0.000	0.005	1.995	0.001	0.999	0.0358	0.0179	Production palm oil
TXCAP	14	0.001	0.036	0.963	0.001	0.999	0.0693	0.0346	Total vegetable oil expend/cap
COPCR	14	0.030	0.081	0.890	0.351	0.619	0.0874	0.0442	Copra crush
PDCCN	14	0.001	0.013	0.986	0.091	0.909	0.0433	0.0216	Production coconuts
LLPDCPO	14	0.000	0.008	1.992	0.002	0.998	0.0007	0.0003	Log of production CPO variable
PDCCO	14	0.022	0.041	0.937	0.336	0.642	0.1084	0.0549	Production CCO
SHCCO	14	0.000	0.016	0.984	0.080	0.920	0.0596	0.0298	Share of oil expnediture, CCO
SHCPO	14	0.000	0.016	0.984	0.080	0.920	0.1755	0.0890	Share of oil expenditure, CPO
LTXCAP	14	0.000	0.046	0.954	0.002	0.998	0.0126	0.0063	Log total oil expenditures/CAP
DIFNUT	14	0.000	0.037	0.963	0.101	0.899	0.0589	0.0295	Log of fresh use variable
HACOP	14	0.000	0.027	0.973	0.014	0.986	0.0129	0.0064	Area copra

BIBLIOGRAPHY

Akiyama, T. and P.K. Trivedi (1987), "Vintage Production Approach to Perennial Crop Supply: An Application to Tea in Major Producing Countries". Journal of Econometrics, 36: 133-161, North Holland.

Bennet, Christopher and Ricardo Godoy (1988), "The Indonesian Copra and Coconut Marketing Systems: A Background Study" (unpublished).

Blancifort', Laura (1984), "Habits and Autocorrelation in the Almost Ideal Demanu System Applied to Food", Economic Research Service Report No. AGES 831128, USDA, Washington, D.C.

Deaton, Angus and John Muellbauer (1980), Economics and Consumer Behavior, Cambridge University Press.

Director General of Estates (1988), Repelita V, Tree Crop Subsector, (draft), Jakarta.

Manser, M.E. (1976), "Elasticities of Demand for Food: An Analysis Using Nonadditive Utility Functions Allowing for Habit Formation," Southern Economic Journal, 43:879-891.

World Bank (1988), Indonesia: The Transmigration Program in Perspective, Washington, D.C.

__________ (1989), Indonesia: Strategies for Sustained Development of Tree Crops, Washington, D.C.

PRE Working Paper Series

	Title	Author	Date	Contact for paper
WPS360	Compounding Financial Repression with Rigid Urban Regulations: Lessons of the Korea Housing Market	Bertrand Renaud	January 1990	L. Victorio 31009
WPS361	Housing and Labor Market Distortions in Poland: Linkages and Policy Implications	Stephen K. Mayo James I. Stein	January 1990	L. Victorio 31009
WPS362	Urban Property Taxation: Lessons from Brazil	William Dillinger	January 1990	L. Victorio 31009
WPS363	Paying for Urban Services: A Study of Water Vending and Willingness to Pay for Water in Onitsha, Nigeria	Dale Whittington Donald T. Lauria Xinming Mu	January 1990	L. Victorio 31009
WPS364	Financing Urban Services in Latin America: Spatial Distribution Issues	Gian Carlo Guarda	January 1990	L. Victorio 31009
WPS365	Cost and Benefits of Rent Contiol in Kumasi, Ghana	Stephen Malpezzi A. Graham Tipple Kenneth G. Willis	January 1990	L. Victorio 31009
WPS366	Inflation, Monetary Balances, and the Aggregate Production Function: The Case of Colombia	Robert Buckley Anupam Dokeniya	January 1990	L. Victorio 31009
WPS367	The Response of Japanese and U.S. Steel Prices to Changes in the Yen-Dollar Exchange Rate	Panos Varangis Ronald C. Duncan	March 1990	D. Gustafson 33714
WPS368	Enterprise Reform in Socialist Economies: Lease Contracts Viewed as a Principal-Agent Problem	Guttorm Schjelderup		
WPS369	Cost Recovery Strategy for Rural Water Delivery in Nigeria	Dale Whittington Apia Okorafor Augustine Akore Alexander McPhail	March 1990	V. David 33736
WPS370	Export Incentives, Exchange Rate Policy, and Export Growth in Turkey	Ismail Arslan Sweder van Wijnbergen		
WPS371	Tariff Valuation Bases and Trade Among Developing Countries ... Do Developing Countries Discriminate Against Their Own Trade?	Refik Erzan Alexander Yeats	February 1990	J. Epps 33710
WPS372	Long-Term Outlook for the World Economy: Issues and Projections for the 1990s	Shahrokh Fardoust Ashok Dhareshwar	February 1990	J. Queen 33740

PRE Working Paper Series

	Title	Author	Date	Contact for paper
WPS373	Are Better-off Households More Unequal or Less Unequal?	Lawrence Haddad Ravi Kanbur	March 1990	J. Sweeney 31021
WPS374	Two Sources of Bias in Standard Partial Equilibrium Trade Models	Samuel Laird Alexander J. Yeats	February 1990	J. Epps 33710
WPS375	Regional Disparities, Targeting, and Poverty in India	Gaurav Datt Martin Ravallion	March 1990	C. Spooner 30464
WPS376	The World Economy in the Mid-1990s: Alternative Patterns of Trade and Growth	Colin I. Bradford, Jr.		
WPS377	Security for Development in a Post-Bipolar World	John Stremlau		
WPS378	How Does the Debt Crisis Affect Investment and Growth? A Neoclassical Growth Model Applied to Mexico	Patricio Arrau		
WPS 379	Implications of Policy Games for Issues of High Inflation Economies	Miguel A. Kiguel Nissan Liviatan		
WPS380	Techniques for Railway Restructuring	Lee W. Huff Louis S. Thompson	March 1990	S. Shive 33761
WPS381	Trade in Banking Services: Issues for Multilateral Negotiations	Alan Gelb Silvia Sagari	March 1990	W. Pitayatonakarn 37666
WPS382	The Indonesian Vegetable Oils Sector: Modeling the Impact of Policy Changes	Donald F. Larson	March 1990	D. Gustafson 33714
WPS383	On the Relevance of World Agricultural Prices	Yair Mundlak Donald F. Larson	March 1990	D. Gustafson 33714
WPS384	A Review of the Use of the Rational Expectations: Hypothesis in Models of Primary Commodity Prices	Christopher L. Gilbert		
WPS385	The Principles of Targeting	Timothy Besley Ravi Kanbur	March 1990	J. Sweeney 31021
WPS386	Argentina's Labor Markets in an Era of Adjustment	Luis A. Riveros Carlos E. Sanchez	March 1990	R. Luz 39059
WPS387	Productivity and Externalities: Models of Export-Led Growth	Jaime de Melo Sherman Robinson	March 1990	M. Ameal 37947